Relationship between stature level and success in elite judo: an analysis on four consecutive Olympic Games

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Paolo Riccardo Brustio[1], Gennaro Boccia[1,2], Paolo Moisè[3], Luca Laurenzano[3], Corrado Lupo[3]

[1] NeuroMuscularFunction | Research Group, School of Exercise and Sport Sciences, Department of Medical Sciences, University of Torino, Torino, Italy

[2] CeRiSM Research Center "Sport, Mountain, and Health", Rovereto, (TN), Italy

[3] School of Exercise and Sport Sciences, Department of Medical Sciences, University of Torino, Turin, Italy

Corresponding author:
Paolo Riccardo Brustio
NeuroMuscularFunction | Research Group, School of Exercise and Sport Sciences, Department of Medical Sciences, University of Torino, Torino, Italy
P.za Bernini 12, 10143 Torino, Italy
Phone: 0039 0117764708
Fax: 0039 011748251
Email addresses: paoloriccardo.brustio@unito.it

Abstract

Purpose: The rationale of our study derived from the important changes in judo rules, with particular consideration of the leg grabs. Therefore, the present study aimed at demonstrating the relationships between the stature and the success in elite judo matches, in relation to both genders and seven weight categories.

Methods: Stature levels and final ranking position of each participant were recorded on the base of the year of Olympic Game (Athens 2004, Beijing 2008, London 2012, Rio 2016), gender, and weight class. A one-way ANCOVA was applied to determinate possible differences ($p \leq 0.05$) among Judoka's statures related to each Olympic Game.

Results: Results showed that no difference was reported for stature level of each Judo Olympic Game in all and only male Judoka. Differently, for female, difference on Judoka's stature levels among ranking positions ($p = 0.007$) generally emerged, reporting increases in stature levels between the first and the fifth (from 163.62 ± 7.95 to 167.90 ± 8.88 cm; $p = 0.004$), and the seventh (from 163.62 ± 7.95 to 168.26 ± 8.53 cm; $p = 0.016$) ranking position.

Conclusion: Considering the weak evidence of a relationship between stature and Judo successful in the analyzed four Olympics Games, it can speculate that no taller Judoka's advance was determined by the rule changes regarding the leg grabs.

Keywords: Martial arts; World ranking; Professional sports; Match outcome; Performance evolution.

Introduction

Founded by a Jigoro Kano in 1882, judo is primarily considered as a method of physical, mental and moral education (Kano 1994). Afterwards, judo was considered a sport combat and included in Olympic Games in the editions of Tokyo 1964 and Barcelona 1992 for the men's and women's competitions, respectively (Sato 2013).

At present, judo Olympic Games are organized in relation to seven body mass categories (men: <60kg, 60-66kg, 66-73kg, 73-81kg, 81-90kg, 90-100kg, >100kg; women: <48kg, 48-52kg, 52-57kg, 57-63kg, 63-70kg, 70-78kg, >78kg) with matches lasting 4 minutes both for men's and women's competitions and of 3 or 2 minutes and half for veteran (SOR 2017). Crucial actions such when a judoka with control throws with a real impact on the back with considerable force and speed an other Judoka (ippon), an immobilization that blocks the opponent for 20 seconds to the ground after the (osaekomi waza), an action that would result in a hyperextension of the elbow (kansetsu-waza) or suffocation (shime-waza), determine the final match outcome before the ending of the regular period. Extra time (with no limitation) is provided in case of tie score at the end of the regular match period (i.e., Golden Score) and the contest end when any technical score is given or when a player receives a penalization and total amount of penalisation was high then the opponent (Federation 2017)

Research on judo has been able to mainly provide performance and physiological information. In particular, elite judo matches consist of 20 to 30 seconds of high-intensity effort interposed by approximately 10 seconds of pause, determining 2:1 or 3:1 effort to pause ratios (Marcon, Franchini et al. 2010). Therefore, judo performance could be defined as a discipline with an important involvement of lactate anaerobic mechanism, especially during the last match phases, despite an appreciable contribution of the aerobic mechanism has been also demonstrated (Sbriccoli, Bazzucchi et al. 2007). In elite Judoka, aerobic power has been observed stands at good values (VO2max = 4:49 I.min-1; 59.2 mL.kg-I.min-I), with a slight

decrease in the higher weight categories (Thomas, Cox et al. 1989). For sub-elite male Judoka, the average lactate recorded after a 5-min simulated match was 12.3 mmol/l (Degoutte, Jouanel et al. 2003), however, peaks of 25.1 mmol/l were also recorded for elite Polish Judoka who performed a series of matches in the same day (Laskowski, Kujach et al. 2012).

Judo has been studied also from a technical and tactical point of view, highlighting how a considerable occurrence of different throwing techniques and the variability of directions, in which these techniques were applied, were significantly correlated with the number of matches won as well as the number of points and ippon scored (Franchini, Sterkowicz et al. 2008). In particular, the large occurrence of techniques has been highlighted as the most effective match strategy to improve the unpredictability of the actions which consequently disrupt the planning and execution of effective responses by the opponent (Calmet and Ahmaidi 2004).

However, successively to the publication of the above mentioned studies on technical and tactical judo performance, important changes were provided in judo rules, with particular consideration of the leg grabs. In particular, before 2011, actions directly aimed at grabbing or immobilizing the opponent's legs have been allowed both during offensive and defensive match phases (Han 2015). On the contrary, in the period between 2011 and 2013, these actions were limited exclusively to the defensive phases and as consequence of specific and preliminary offensive actions (Han 2015). Actually, any judo athletes performing actions characterized by the direct grab and immobilization of the opponent's legs are disciplined with first by Shido (i.e., "Slight" infringements) and secondly by Hansoku-make (i.e., "Grave" infringements) and consequently disqualified (Federation 2017) Therefore, coherently to the current judo rules, it would hypothesized that Judoka probably tend to more often maintain an upright body position, in order to perform effective grabs on the opponent's

upper body portions. As consequence, in relation to this hypothesized match scenario, Judoka with high stature levels could be associated to high occurrences of successful matches.

Although in other sports, ranging from net-games, such as beach volley and tennis (Giatsis, Tili et al. 2011, Ma, Liu et al. 2013), to invasion-games, such as volleyball and basketball (Tucker and Collins 2012), high stature levels have been highlighted as a valuable facilitator of the sport successful, however, no evidence has been provided to demonstrate the corresponding relationship in elite judo performance. Therefore, the present study aimed at demonstrating the relationships between the stature and the success in elite judo matches, in relation to both genders and the seven weight categories. In particular, it has been hypothesized that the changes in Judo rules of the last four judo Olympic Games (i.e., Athens 2004, Beijing 2008, London 2012, Rio 2016) could have favoured the taller athletes to achieve the best ranking positions.

Material and Methods

Participants

The survey included all participants in the judo Olympic Games of Athens 2004, Beijing 2008, London 2012, and Rio 2016. A total of 1495 Judoka were included in the study. Specifically the 60 % (N= 897) was male and the 40% (598) was female. According to same elite Judo coaches, elite Judoka competing into Olympic Games regularly train from a minimum of six to a maximum of nine times per week (excluding the strength training units performed in gym, which may fluctuate from a minimum of two to a maximum of five per week). Each training unit generally consists of 90-180-min and the players have trained at least for 10 years.

Procedures

Data were retrieved from web sites specifically dedicated to the description of Judoka competing into the Athens 2004 (http://library.la84.org/6oic/OfficialReports/2004/Results/Judo.pdf), Beijing 2008 (https://www.hatashitasports.com/UserFiles/2008BeijingResultsbook.pdf), London 2012 (http://www.olympic.org/Documents/Reports/Official%20Past%20Games%20Reports/Summer/ENG/2012-RO-S-London_official_results.pdf), and Rio 2016 (http://it.eurosport.com/judo/rio/2016/result-rio-2016.shtml) Olympic Games. The stature levels and the final ranking position of each participant were recorded in separated electronic worksheets on the base of the year of Olympic Game, genders, and weight class.

Statistical analysis

Using gender and weight categories as covariates, a one-way ANCOVA was applied to determinate if there were significant differences among years of judo Olympic Games on Judoka' stature levels. In addition, controlling for weight categories and years of judo Olympic Games, one-way ANCOVAs were carried out separately for males and females to determinate significant differences among final ranking positions on Judoka' stature levels. A post hoc analysis with a Bonferroni adjustment was performed, where statistically significant differences were observed. The Statistical Package for Social Sciences (SPSS 20.0 for Windows) was used for the analyses. The statistical significance level was set at $p < 0.05$.

Results

Figure 1 presents Judoka's stature levels in relation to the different seven weight categories and years of judo Olympic Games separately for males and females.

[Insert Figure 1 about here]

A one-way ANCOVA was conducted to determine if the Judoka's stature levels was different for years of judo Olympic Games. Judoka's stature levels were not different in the years of judo Olympic Games [$F(1489, 3) = 1.422$, $p = 0.234$].

Considering males, Judoka's stature levels were not different in the ranking positions [$F(5,889) = 0.790$, $p = 0.557$]. Differently, collapsing all weight categories, a difference in Judoka's stature levels across ranking positions emerged [$F(5,590) = 3.459$, $p = 0.004$]. The females ranked in the first position were shorter than those in the third ranking position (-3.7 cm [CI -7.3 to -0.2]; $p = 0.029$), in the fifth ranking position (-4.7 cm [CI -7.9 to -0.9]; $p = 0.001$) and in the seventh ranking position (-4.4 cm [CI -8.3 to -1.2]; $p = 0.029$). However, post-hoc analysis did not show any difference when comparisons were made within each weight categories. Figure 2 shows the mean of Judoka's stature levels in relation to the final rank position and weight categories separately for males and females.

[Insert Figure 2 about here]

Discussion

The present study aimed to investigate the relationships between body height and success in elite judo matches in four consecutive judo Olympic Games (i.e., Athens 2004, Beijing 2008, London 2012, Rio 2016), in relation to gender and seven weight categories of the discipline. The rational of our study derived from the important changes in judo rules, with particular consideration of the leg grabs. In fact, before 2011, the athletes could grab or immobilize the opponent's legs without restrictions during both offensive and defensive match phases. Differently, this action has been restricted to the defensive phases in the competition organized between 2011 and 2013 (Han 2015), and, at present, direct grab and immobilization of the opponent's legs is not permitted, and determines the match disqualification of athlete (Han 2015, NBCUniversal Judo 101 2016). These rule changes influenced the key elements

of the judo combat (Franchini, Takito et al. 2013), being the most used counterattack technique in leg grabbing *(*e.g., *kata-guruma, kuchiki-taoshi, morote-gari, kibisu-gaeshiand sukui-nage*) (Miarka, Julio et al. 2010, Franchini, Takito et al. 2013). Therefore it has been hypothesized that the changes in Judo rules (Han 2015, NBCUniversal Judo 101 2016) could have favoured the taller Judoka athletes to achieve the best ranking positions in the last four Olympic Games (i.e., Athens 2004, Beijing 2008, London 2012, Rio 2016). Actually, the findings of the present study showed no significant differences in stature levels in relation to the four consecutive judo Olympic Games, determining the rejection of the experimental hypothesis. In other words, it can be speculated that no taller Judoka's advance was determined by the rule changes regarding the leg grabs.

In consideration of previous analyses, the finding of the present study could be considered as controversial with respect to previous results, where the rule changes seem to influence the athletes' management of the match (i.e., score and penalties) (Franchini, Takito et al. 2013). In fact, in line with previous studies focused on the anthropometric profile of Judoka (Dopsaj, Todorov et al. 2013), positive relationships between the body height and the seven body mass categories were reported in both judoka genders, highlighting a strong relationship between body height and mass. Furthermore, focusing on gender and ranking positions, it was found significant differences in female Judoka's stature levels among ranking positions, but not in male Judoka's stature levels. In particular, it was found as female Judoka's stature levels were inversely correlated with ranking positions. Indeed, the athletes in the best rank positions presented taller stature levels compared with the athletes in lower rank positions. These different trends observed in male and female Judoka might be due to the different techniques frequently used during the match (Sterkowicz, Sacripanti et al. 2013). Indeed the body height of the Judoka was moderately connected with the preferred techniques in combat (Lech, Sterkowicz et al. 2007). Differently from return and territorial sports, such

as beach volley (Giatsis, Tili et al. 2011) and tennis (Ma, Liu et al. 2013), as well as invasion-games, such as volleyball and basketball (Tucker and Collins 2012), the present study reported that high stature levels is not a valuable facilitator of the sport success in Judo.

However, some limitations should be considered for the present work. First, only athletes that participated in last four Olympic Games (i.e., Athens 2004, Beijing 2008, London 2012, Rio 2016) were involved in the experimental sample, and therefore analyses were exclusively focused on top-elite Judoka. Therefore, future studies should investigate whether there are differences in body height between sub-elite and elite athletes, highlighting possible influences into the corresponding ranking position for effect of the change of rules. Furthermore, in this study, the number of the athletes participating in each single Olympic Game was not equal and the same athletes could have been included in our dataset more than once.

Conclusions

In conclusion, although the main finding of the present study showed no difference in body height in relation to ranking positions after the rule changes in last four consecutive judo Olympic Games (i.e., Athens 2004, Beijing 2008, London 2012, Rio 2016), the enlargement of the experimental sample and the involvement of athletes performing in further official competitions could better clarify this result. In other words, differences in body height in relation to ranking positions could emerge only after further years and international judo competitions, as effect of a slow change related to the training methodologies and performance strategies. Finally, further research focused on the possible evaluation of Judoka should be promoted also by means of other investigation related to training monitoring (Casolino, Cortis et al. 2012, Lupo, Capranica et al. 2014, Lupo, Capranica et al. 2017) and physical effects after performance (Chiodo, Tessitore et al. 2012).

Compliance with ethical standards

Conflict of interest The authors declare no conflict of interest.

Ethical approval The study was approved by an independent local Ethical Committee and performed in accordance with the Helsinki Declaration.

Informed consent No informed consent due to the nature of the study.

Figure caption

Figure 1. Mean (±SD) body height of participant to Judo Olympic games from 2004 to 2016 separated for gender and weight class.

Figure 2. Mean (±SD) body height of participant to Judo Olympic games separated for gender and weight categories in relation to the ranking positions.

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